1140.01 General

The function of a noise barrier is to reduce traffic noise levels at adjoining areas. The noise abatement decisions are made during the environmental stage of the project development process. This is a highly interactive process. Before a noise barrier is designed, the department must be confident that there is significant need, a cost effective and environmentally acceptable noise barrier, a source of funds, and acceptance by adjacent property owners, local governmental agencies, and the general public.

The designer will find the following preliminary design information in the noise report:

- Sources of noise
- Noise receiver locations
- Predicted level of noise reduction
- Locations of existing and future noise impacts along the project corridor
- Barrier location and height recommendations based on what is feasible and reasonable

Design of a noise barrier project is the result of a team effort coordinated by the project engineer.

This chapter addresses the factors that are considered when designing a noise barrier and the associated procedures and documentation requirements.

1140.02 References

Environmental Procedures Manual, M 31-11, WSDOT

Guide Specifications for Structural Design of Sound Barriers, AASHTO

Roadside Manual, M 25-30, WSDOT

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01, WSDOT

1140.03 Design

The two basic types of noise barriers are the earth berm and the noise wall. An earth berm can be constructed to the full height required for noise abatement or to partial height in conjunction with a noise wall to reach the required height. A noise wall can be made of concrete, masonry, metal, wood, or other approved innovative products, and can be supported by spread, pile, shaft, or trench footings.

Consideration of the noise report and the visual characteristics of adjacent land forms, vegetation, and structural elements (such as buildings, bridges, and retaining walls) will determine whether a proposed noise barrier might be berm, wall, or both.

An earth berm should be the primary alternative if the visual and environmental quality of the corridor would be preserved or enhanced and materials and right of way widths are available. See the *Roadside Manual* for criteria for determining if a vegetated earth berm is appropriate.

The region uses the noise report and other environmental documents (see the *Environmental Procedures Manual*) to help determine the location, exposure conditions, length, and heights of the proposed noise barrier.

To design and locate a noise barrier of any kind, consider the following:

- Desired noise abatement
- Future right of way needs
- Cost and constructibility
- Visual character and quality of the corridor
- Future maintenance of the noise barrier and the whole right of way
- Wind

- Supporting soil
- Earthquakes
- Ground water
- Existing drainage systems and water courses
- Exposure to vehicular impacts
- Potential vandalism
- Existing vegetation and roadside restoration required
- Access for maintenance equipment and enforcement, traffic service, and emergency vehicles
- Pedestrian and bicycle access
- Available and attainable width of right of way for berms
- Aesthetic and structural characteristics of available wall designs
- Visual compatibility of each wall design with other transportation structures within the corridor
- Construction limits for footings
- Access to, and maintenance of, right of way behind a wall, including drainage structures
- Use of right of way and wall by adjacent property owners
- Drainage and highway runoff
- Drainage from adjacent land
- Existing utilities and objects to relocate or remove
- Water and electricity; needs, sources, and access points

A noise barrier must not have anything (such as bridge columns, light fixtures, or sign supports) protruding in such a way as to present a potential for snagging vehicles.

(1) Earth Berm

(a) Berm slopes are a function of the material used, the attainable right of way width, and the desired visual quality. Slopes steeper than 2H:1V (3H:1V for mowing) are not recommended. Design the end of the berm with a lead-in slope of 10H:1V and curve it toward the right of way line.

(b) See Chapter 710 and the Standard Plans for guidance on redirectional land forms if the berm is to function as a traffic barrier.

(2) Noise Wall

(a) When feasible, to encourage competitive bidding, include several alternate noise wall designs in the contract and permit the contractor to submit alternate designs under the value engineering specification.

(b) There are standard noise wall designs in the Standard Plans manual. Additional designs are in various stages of development to become standard plans. The draft-standard design sheets and other preapproved plans are available from the Bridge and Structures Office. The Bridge Office also works with the regions to facilitate the use of other designs as bidding options.

(c) When a noise wall has ground elevations that are independent of the roadway elevations, a survey of ground breaks (or cross sections at 25-ft intervals) along the entire length of the wall is needed for evaluation of constructibility and to assure accurate determination of panel heights.

(d) Size of openings (whether lapped, door, or gated) depends on the intended users. Agencies such as the local fire department can provide the necessary requirements. Unless an appropriate standard plan is available, such openings must be designed and detailed for the project.

(e) When a noise wall is inside the Design Clear Zone, design its horizontal and vertical (ground elevation) alignment as if it were a rigid concrete traffic barrier. See Chapter 710 for maximum flare rates.

(f) Provide a concrete traffic barrier shape at the base of a new noise wall constructed 12 ft or less from the edge of the nearest traffic lane. The traffic barrier shape is optional at the base of the new portion when an existing vertical-faced wall is being extended (or the existing wall may be retrofitted for continuity). Standard Concrete Barrier Type 4 is recommended for both new and

existing walls except when the barrier face can be cast as an integral part of a new wall. Deviations may be considered but require approval as prescribed in Chapter 330. For deviations from the above, deviation approval is not required where sidewalk exists in front of the wall or in other situations where the wall face is otherwise inaccessible to traffic.

See Chapter 710, "Traffic Barriers," for flare rates and approach slopes for concrete barriers.

(g) To designate a standard noise wall, select the appropriate general special provisions and state the standard plan number, type, and foundation type. For example: Noise Barrier Standard Plan D-2a, Type 1A, Foundation D1.

Wall type is a function of exposure and wind speed. See Figure 1140-1.

A geotechnical/soils report identifying the angle of internal friction f and the allowable bearing pressure is needed for selection of a standard foundation. The standard spread footing designs require an allowable bearing pressure of 1 Tsf. The standard trench and shaft footing designs require a f of at least 32° for D1 and 38° for D2.

A special design of the substructure is required for noise walls on substandard soil, where winds exceed 90 mph, and for exposures other than B1 and B2 as defined in Figure 1140-1.

1140.04 Procedures

The noise unit notifies the Project Engineer's Office when a noise barrier is recommended in the noise report.

	Exposure				
	B1		B2		C
Wind Speed	80 mph	90 mph	80 mph	90 mph	
Wall Type	A	B	C	D	Special Design*

Wind speed is according to Figure 1-2.1.2.A of the (AASHTO) *Guide Specifications for Structural Design of Sound Barriers*. Assume the wind to be perpendicular to the wall on both sides and design for the most exposed side.

Exposure is determined by the nature of the immediately adjacent ground surface and the extension of a plane at the adjacent ground surface elevation for 1,500 ft to either side of the noise wall:

Exposure B1 = Urban and suburban areas with numerous closely spaced obstructions having the size of single-family dwellings or larger that prevail in the upwind direction from the noise barrier for a distance of at least 1,500 ft.

Exposure B2 = Urban and suburban areas with more open terrain not meeting the requirements of Exposure B1.

Exposure C = Open terrain with scattered obstructions that include flat, open country, grasslands, and elevated terrain.

*For a noise wall with Exposure C, on a bridge or overpass, or at the top of a slope, consult the Bridge and Structures Office, as a special design will probably be necessary.

Standard Noise Wall Types
Figure 1140-1

The Project Engineer's Office is responsible for interdisciplinary teams, consultation, and coordination with the public, noise specialists, maintenance, construction, region's Landscape Architecture Office (or the Roadside and Site Development Services Unit), right of way personnel, Materials Laboratory, Principal Architect (in the Bridge and Structures Office), Bridge and Structures Office, CAE Support Team, Access and Hearings Engineer, consultants, and many others.

The region evaluates the soils (see Chapters 510 and 1110) and, if a noise wall is contemplated, obtains a list of acceptable wall design options by sending information pertaining to soils and drainage conditions, the alignment, and heights of the proposed wall to the Principal Architect.

If a vegetated earth berm is considered, see the *Roadside Manual* for procedures.

The Principal Architect coordinates with the Bridge and Structures Office, Hydraulics Design Branch, Geotechnical Branch, and the region to provide a list of acceptable standard, draft-standard, and preapproved-proprietary noise wall designs, materials, and finishes that are compatible with existing visual elements of the corridor. Only wall designs from this list may be considered as alternatives. Design visualizations of the highway side of proposed walls (available from the CAE Support Team in Olympia) must be limited to options from this list. The visual elements of the private-property side of a wall are the responsibility of the region unless addressed in the environmental documents.

After the noise report, any changes to the dimensions or location of a noise barrier must be reviewed by the appropriate noise unit to determine the impacts of the changes on noise abatement.

On limited access highways, any opening in a wall or fence (for pedestrians or vehicles) must be coordinated with the Access and Hearings Engineer and approved by the State Design Engineer.

On nonlimited access highways, an access connection permit is required for any opening (approach) in a wall or fence.

The Bridge and Structures Office provides special substructure designs to the regions upon request; reviews contract design data related to standard, draft-standard, and preapproved designs; and reviews plans and calculations that have been prepared by others. (See Chapter 1110.)

Approval of the Bridge and Structures Office and the Architecture Office is required for any attachment or modification to a noise wall and for the design, appearance, and finish of door and gate type openings.

Approval of the Principal Architect is required for the final selection of noise wall appearance and finish.

1140.05 Documentation

The following documents are to be preserved for future reference in the project file. See Chapter 330.

- ☐ Noise report
- ☐ Geotechnical/soils report
- ☐ List of design options considered and summary of evaluations
- ☐ Report on impacts due to changes
- ☐ Openings approvals
- ☐ Wall attachments approval
- ☐ Final selection approval

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